Environmental Assessment
Rehabilitate Sulphur Bank Road and Trail
February 2003

Hawai`i Volcanoes National Park

Hawai`i

TABLE OF CONTENTS

INTRODUCTION

Hawai`i Volcanoes National Park is located on the southeastern end of the island of Hawai`i, the southern most island in the Hawaiian chain. Within the park are Mauna Loa and Kilauea, two of the world's most active volcanoes. The park's 1985 Statement for Management observes that the purpose of the park is to conserve the volcanic features, endemic Hawaiian ecosystem, Hawaiian cultural and archeological remains, and inherent scenic values for visitor enjoyment and appreciation and scientific and historic values. Accomplishment of this stated purpose enables people to understand the powerful volcanic forces, fragile biota, and ways of life that characterize the Hawaiian Islands.

Sulfurous steam rises through vents and cracks in the earth's surface at Sulphur Bank, located along the rim of Kilauea. The area is important to Native Hawaiians for its association with Pele, a creative force deity. Roads, trails, shelters, and sampling wells were constructed in the area to accommodate the needs of researchers, park administrators, and visitors. This environmental assessment (EA) addresses the need to remove the incompatible Sulphur Bank Road, improve the Sulphur Bank Trail, provide for handicapped accessibility, and improve interpretive facilities.

PURPOSE OF AND NEED FOR ACTION

Purpose and Need

The primary purposes for the rehabilitation are to avoid adverse impacts to the geothermal features from the presence of the road and vehicles, remove the visual intrusion of motor vehicles at Sulphur Bank, provide for greater accessibility, and provide for visitor safety and interpretation. The rehabilitation includes removing the Sulphur Bank Road, rehabilitating the Sulphur Bank Trail, adding a new trail, designating a handicapped accessible parking space at Steam Vents, and adding interpretive wayside exhibits. No increased visitation is expected at Sulphur Bank or Steam Vents.

Sulphur Bank is the only readily accessible solfatara field, a localized area of heat and sulfur deposition, in the park. The area is fragile because of the ongoing, natural chemical alteration of the substrate; cracks and holes can open unexpectedly. The asphalt paved Sulphur Bank Road lies directly on top of several geothermal features and immediately adjacent to others. The road and the vehicles affect geothermal processes; the natural flow of sulfurous gases and fumes is interrupted. As motor vehicles navigate the narrow road and short diameter turnaround, traffic congestion is frequent. Vehicles routinely pull off the road and onto the Sulphur Bank resource to go around other vehicles or to park.

A new trail would be added to facilitate greater visitor access to Sulphur Bank. The existing Sulphur Bank Trail would be improved to provide for easier and safer access from the Kilauea Visitor Center and Steam Vents; portions of the trail would be accessible. Currently, the Sulphur Bank Trail is not accessible to persons with mobility disabilities and visitors are exposed to potentially unsafe conditions along the trail because of changing subsurface conditions. Improved interpretation would better inform visitors of the site's natural and cultural history and geologic hazards. Handicapped accessible parking would be designated at Steam Vents, a Sulphur Bank trailhead where there currently is no designated handicapped accessible parking there.

Management and Planning History

Sulphur Bank was a visitor attraction before the 1916 establishment of Hawai`i Volcanoes National Park and it remains a popular point of interest today. While not specifically mentioning the Sulphur Bank area, the park's 1975 Master Plan describes the continued use of the Crater Rim Drive, and the need to accommodate visitor use in the zone around the rim of the Kilauea Caldera. The 1985 Statement for Management contains management objectives for "providing safe routes of access for visitors to significant interpretive features and visitor facilities . . ." (p. 31)., and for preserving “the evolving natural scene such as calderas and rift zones, steam and sulfur banks, the profile of Mauna Loa, and the associated native ecosystems” (p. 29). The 2001-2005 Strategic Plan for Hawai`i Volcanoes National Park states that a purpose of the park is protecting volcanic landscapes and processes (p. 4). The proposed action is consistent with the direction contained in all of these management documents.

Issues and Impact Topics

The following issues and impact topics were identified through interdisciplinary scoping with staff from Hawai`i Volcanoes National Park, Hawaiian Volcano Observatory, U. S. Geological Survey Pacific Island Ecosystems Research Center, and with the Hawai`i Volcanoes National Park Kupuna Community Group.

Resource Values

The resource values of the geothermal features including the visual quality of Sulphur Bank and the surrounding area are being degraded by the road and vehicles in the immediate resource area.

Safety

Pedestrians face a high risk of falling into cracks and geothermal features if they walk off-trail through the Sulphur Bank area. The proposal would give better definition to the pedestrian trail, and provide interpretation about the hazards involved in going off the trail.

Accessibility

The steep grades, rough surface treatment on the trails, and lack of designated handicapped accessible parking limits visitors with mobility disabilities from access to the Sulphur Bank area.

Interpretation

Visitor understanding of the natural and cultural history and geologic hazards is hindered by the lack of interpretive wayside exhibits.

Impact Topics Dismissed from Further Analysis

Wetlands and Floodplains

Executive Orders 11988 and 11990, “Floodplain Management and Wetland protection,” direct the National Park Service (NPS) to avoid, to the extent possible, the long and short term adverse impacts associated with modifying or occupying floodplains and wetlands. They also

require the NPS to avoid direct or indirect support of floodplain or wetland development whenever there is a practical alternative. There are no wetlands or floodplains in the area affected by this proposal. Therefore, wetlands and floodplains were dismissed as impact topics in this document.

Air Quality

Hawai`i Volcanoes National Park is a mandatory Class 1 area where air quality degradation is unacceptable under the Clean Air Act. Air quality and visibility in the park is generally excellent except when affected by naturally occurring vog (volcanic gases). When the predominate trade winds are low velocity, vog from the Kilauea Volcano enters the area, which degrades the air quality. On a daily basis, the air quality at the Sulphur Bank area and Steam Vents is affected by sulfur and other volcanic fumes that escape through the vents. Dispersed dust and mobile exhaust emissions associated with the rehabilitation project would have a negligible effect on air quality and visibility due to the temporary and small scale nature of the project. Therefore, air quality is dismissed as an impact topic in this document.

Environmental Justice

Executive Order 12898, "General Actions to Address Environmental Justice in Minority Populations and Low Income Populations," requires all federal agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high and adverse human health or environmental effects of their programs and policies on minorities and low income populations and communities. The proposed action would not have health or environmental effects on minorities or low-income populations or communities. Therefore, environmental justice was dismissed as an impact topic in this document.

Prime or Unique Farmlands

In August 1980, the Council on Environmental Quality (CEQ) directed that federal agencies must assess the effect of their actions on farmland soils classified by the U.S. Department of Agriculture's Conservation Service (NRCS) as "prime" or "unique." Prime or unique farmland is defined as soil that particularly produces general crops such as common foods, forage, fiber, and oil seed; unique farmland produces specialty crops such as fruits, vegetables, and nuts. There are no prime or unique farmlands included in the area affected by this project. Therefore, prime or unique farmlands were dismissed as impact topics in this document.

Indian Trust Resources

Secretarial Order 3175 and ECM95-2 require the federal agencies to address environmental impacts of their proposed actions on Indian Trust Resources in any environmental document. There are no Indian Trust Resources in Hawai`i. Therefore, Indian Trust Resources was dismissed as an impact topic in this document.

Wilderness

NPS Management Policies 2001 directs park managers to take into account wilderness characteristics and values, including the primeval character and influence of the wilderness; the preservation of natural conditions (including the lack of human-made noise); and assurances that there would be outstanding opportunities for solitude, that the public would be provided with

a primitive and unconfined type of recreational experience, and that wilderness would be preserved and used in an unimpaired condition. All management decisions affecting wilderness must be consistent with the minimum requirement concept. This concept is a documented process used to determine whether administrative activities affecting wilderness resources or the visitor experience are necessary, and how to minimize impacts. The project area is five miles from the nearest wilderness boundary. There are no wilderness resources in or adjacent to the project area. There are no wilderness visitors who would see or hear the work. Therefore, Wilderness was dismissed as an impact topic.

Rare Plants

NPS Management Policies 2001 directs park managers to inventory, monitor, and manage state and locally listed plant species in a manner similar to the treatment of federally listed species, to the greatest extent possible. Managers are also directed to inventory other native species that are of special management concern to parks (such as rare, declining, sensitive, or unique species and their habitats) and manage them to maintain their natural distribution and abundance. Park botanists found no endangered, threatened, or Species of Concern plants within the project area. Therefore, Rare Plants was dismissed as an impact topic.

ALTERNATIVES

Alternative A (Preferred Alternative)

This alternative would remove approximately 10,000 square feet of existing asphalt roadway at Sulphur Bank, and would rehabilitate the road area by restoring the original grades and native vegetation. Approximately 1,000 linear feet of new trail would be added at Sulphur Bank (see maps); a portion of the trail would follow the former roadbed. Approximately 300 linear feet of trail would be added at Steam Vents to facilitate handicapped accessibility between the Steam Vents parking area and the Sulphur Bank Trail. All new trail segments would be at least 4-feet wide with grades of 5% or less and would meet accessibility standards.

Approximately 7,000 linear feet of existing trail between the Kilauea Visitor Center parking area and the Steam Vents parking area would be rehabilitated to a consistent 4-foot width, with 5-foot wide trail segments located at intervals to permit passing of wheelchair users. Sections of the trail would be regraded to 5% or less so that they would be accessible to persons with mobility impairments. Some sections would remain greater than 5% and would be signed as more difficult for persons with disabilities to use. Trail rehabilitation may require excavating 6 inches to 8 inches below the current trail surface. Gravel trail surfaces would be stabilized using structural plastic fabric underneath the trail surface, a stabilizing agent mixed with the gravel in the upper 4 inches of the trail prism, or replaced with asphalt. Some trail sections may include a boardwalk. The exact placement and design of the proposed boardwalk sections have not been determined, and cannot be shown with accuracy on the map at this time. They would generally be in the area of the existing Sulphur Bank turnaround, or cul-de-sac, which would be removed and would be limited to already disturbed ground. Short sections of trail would be rebuilt as raised platforms or decks to bridge unstable or fragile geothermal features.

One handicapped accessible parking space would be designated at the Steam Vents parking area. A portion of the existing gravel parking area, adjacent to the paved parking area, would be paved with asphalt to accomplish this.

Interpretive wayside exhibits would be installed adjacent to the trails.

The Class “C” cost estimate for implementation of this alternative is $375,450.

Alternative B

This alternative is similar to Alternative A; however, new trail would be limited to the Sulphur Bank roadbed (see maps).

The Class “C” cost estimate for the implementation of this alternative is $375,450.

Alternative C

This is the no action alternative. The existing Sulphur Bank Road would remain. The trail between the Kilauea Visitor Center and Steam Vents through the Sulphur Bank area would not be upgraded and made accessible to persons with disabilities. There would continue to be no designated handicapped accessible parking at Steam Vents. Interpretive wayside exhibits would not be installed.

Alternatives Dismissed

An alternative to retain the road into the Sulphur Bank area, and construct parking spaces for disabled visitors adjacent to the road was considered, but dismissed. It would continue to cause unacceptable impacts to the Sulphur Bank resource. This alternative would also have the effect of separating disabled visitors from other visitors, and not integrating them into the mainstream of the visitor experience as required by NPS policy.

Environmentally Preferred Alternative

Alternative A and B are similar; both alternatives remove the adverse impacts of the Sulphur Bank asphalt road and vehicles from the geologic resource; provide a Sulphur Bank handicapped accessible trail; enhance safety through trail rehabilitation and location; provide handicapped accessible parking at Steam Vents; and increase safety knowledge, resource awareness, and resource protection through sequential, interpretive wayside exhibits. Alternative C, the no action alternative, does none of these.

Alternative A is the environmentally preferred alternative because it restores all of the Sulphur Bank roadbed and provides for a greater resource experience without resource degradation. New trail segments would allow visitors to explore more of the Sulphur Bank resource. There may be less off-trail use, and in turn, enhanced visitor safety because of the new Sulphur Bank trail segments. A handicapped accessible trail connecting the Steam Vents handicapped accessible parking space to the Sulphur Bank Trail would be constructed. Alternative A trail more clearly conveys to the visitor the appropriate direction of travel, along the Sulphur Bank Trail, for the sequentially installed interpretive wayside exhibits. This contributes to greater visitor understanding about safety, resources, and resource protection.

Table 1: Summary of Potential Impacts of Alternatives

Impact Topic	Alternative A – Preferred • Remove Sulphur Bank Road • Restore roadbed • Add new trail at Sulphur Bank and Steam Vents • Rehabilitate existing trail • Designate one accessible Steam Vents parking space • Add interpretive wayside exhibits	Alternative B • Remove Sulphur Bank Road • Restore roadbed • Add new trail on Sulphur Bank roadbed • Rehabilitate existing trail • Designate one accessible Steam Vents parking space • Add interpretive wayside exhibits	Alternative C – No Action • Sulphur Bank Road remains • No new trail • No trail rehabilitation • No accessible Steam Vents parking • No interpretive waysides
Geology	Natural conditions promoted. Off trail use would decrease. Geologic resources protected. Public more informed about resources and hazards.	Impacts similar to Alternative A, except new trail limited to former Sulphur Bank Road. Off-trail use may not decrease.	Vehicle access remains. Continued degradation of Sulphur Bank resource.
Vegetation	Natural conditions promoted. Exotic and native vegetation removed with trail work. Native vegetation restoration on roadbed and along trail.	Impacts similar to Alternative A, except less vegetation removed.	No vegetation removed or restored.
Geothermal Microorganisms	Negligible impact; sulfur and steam vents avoided.	Similar to Alternative A.	No new impacts.
Wildlife	Negligible impacts to wildlife.	Same as Alternative A.	No new impacts.
Threatened and Endangered Wildlife	Negligible impact to nene with mitigation: Nene staff contacted if nene present during construction; post-project monitoring to control roadside grasses.	Same as Alternative A.	No new impacts.
Visitor Use	Only pedestrian access to Sulphur Bank. Improved, safer, and accessible trail. Greater resource access. Greater handicapped accessible access. Steam Vents parking may fill more often. Public more informed about area resources and hazards.	Less new trail reduces visitor experience and understanding of Sulphur Bank resource, which may affect resource protection and visitor safety. Trail configuration more confusing as to best way to travel to experience resource. No Steam Vents handicapped accessible trail to Sulphur Bank Trail.	Vehicle access continues. No accessible trail.
Interpretation	Park interpretive objective met.	Less new trail reduces Sulphur Bank potential as interpretive resource. Trail configuration more confusing as to best way to travel to experience interpretive wayside exhibits.	Park interpretive objective not met.
Visual Quality	Visual quality improved; natural scene would predominate.	Similar to Alternative A, except less new trail.	Road and vehicles remain as visual impacts.
Soundscape	Improved Sulphur Bank natural soundscape.	Same as Alternative A.	Road and vehicles continue to impact soundscape.
Cultural Resources	Adverse impact to Sulphur Bank Road.	No adverse impacts.	No new impacts.

Table 2: Summary of Proposed Action Effects on Known Cultural Resources

Resource	LCS* Number	National Register Status	Action	Proposed Protective Measure	Determination of Effect	Further 106 Actions
Headquarters and Maintenance Areas Historic District	No number	Eligible	Rehab Sulphur Bank Trail from visitor center parking area.	None necessary.	No adverse effect.	Section 106 consultation.
Crater Rim Drive	No number	Eligible	Remove Sulphur Bank Road, regrade, and revegetate.	For structural features within APE**: document, leave in place, or incorporate into rehabilitation.	No adverse effect.	Section 106 consultation.
Sulphur Bank	No number	Eligible	Remove Sulphur Bank Road, regrade, and revegetate; add new trail, rehabilitate existing trail.	Avoid sulfur vents.	No adverse effect.	Section 106 consultation.
Sulphur Bank Road	No number	Eligible	Remove Sulphur Bank Road.	Photographically document road and road features; if shaped stone found, save for use elsewhere.	Adverse effect.	Section 106 consultation.
Sulphur Bank Trail	No number	Eligible	Rehabilitate Sulphur Bank Trail.	Photographically document trail features; leave features in place or incorporate into rehabilitation. Avoid sulfur and steam vents.	No adverse effect.	Section 106 consultation.
KMC Footpath/Old Volcano House Trail	No number	Eligible	Remove Sulphur Bank Road, regrade, and revegetate.	Continue trail across roadbed. Photographically document trail features; leave features in place or incorporate into rehabilitation.	No adverse effect.	Section 106 consultation.
1925 Borehole	No number	Eligible	Remove Sulphur Bank Road, regrade and revegetate.	Avoid disturbing.	No adverse effect.	Section 106 consultation.
Steam Vents	No number	Eligible	Add trail.	Avoid steam vents.	No adverse effect.	Section 106 consultation.

*List of Classified Structures: NPS database for historic structures that are eligible to or listed on the National Register.
**APE: Area of potential effect.

AFFECTED ENVIRONMENT

Overview

This section of the EA discusses the environment affected by removing the Sulphur Bank Road and restoring the roadbed, adding the new trail, rehabilitating the existing trail, adding handicapped accessible parking at Steam Vents, and adding interpretive waysides.

Natural Resources

Natural resources environments include the `ohi`a rain forest, grasslands, steam vent openings, the solfatara field (Sulphur Bank), and the managed landscape near and adjacent to the Pa hula or hula platform, which is by the Kilauea Visitor Center parking lot.

Geology

Kilauea is one of the world's most active volcanoes. It has been a focus for explorers, researchers, and scientists since the early 1800s. The U.S. Geological Survey (U.S.G.S.) Hawaiian Volcano Observatory (HVO) founded in 1912 continues to be a center for scientists researching volcanic processes.

Sulphur Bank was active even before the first written account by William Ellis in 1823. The area is a solfatara field—a localized area of heat and sulfur deposition. Sulphur Bank formed along the base of one of the caldera ring faults. The fault apparently serves as a conduit up which hot magmatic gas and steam can rise.

Sulphur Bank is one of two large solfataras in the park. The other, mostly buried by 19th-century lava flows, is about 1 km east-southeast of Halema`uma`u along another ring fault. At both areas, an oxidation reaction between SO_2 (sulfur dioxide) and H_2S (hydrogen sulfide) gas results in the formation of the yellow native sulfur sublimate. Other minerals deposited by the escaping gas include gypsum, opal, and hematite. The porous, fractured bedrock along the ring fault accounts for the lack of hot springs and geysers. The Sulphur Bank area is rather fragile, owing to ongoing natural chemical alteration of the substrate. Cracks and holes can open unexpectedly, allowing hot sulfurous steam to escape. Care needs to be taken when walking in the area.

Intermittent sampling of gas is conducted by USGS and UH (University of Hawai`i) chemists to trace changes in gas composition. Of significance is the decreased ratio of He (helium) to $CO_2$ (carbon dioxide) before four of the most recent eruptions, including the start of the Pu‘u `O`o eruption in 1983. An unknown aspect of Sulphur Bank is the source of the heat and the magmatic gas. Possibly, a slowly cooling body of magma underlies the area, perhaps intruded when the caldera formed about 500 years ago. This remains only an idea that has proved difficult to test, however, and in fact does not explain the change in the He/CO_2 ratio before eruptions. There remains the possibility that conduits are tapping directly from the main magma reservoir beneath the central part of the caldera.

The Sulphur Bank Road is affecting Sulphur Bank. The natural flow of sulfurous gases and fumes, and mineral deposition, are being affected. The fragile ground surface is affected by vehicle travel on and adjacent to the road.

Steam Vents and the wider area encompassing Steaming Bluff are areas in which heated water emerges from the ground as steam. The steam is generated by heating of rainwater that infiltrates the flat area above the bluff. In contrast to Sulphur Bank, vents on Steaming Bluff and those at Steam Vents emit no magmatic gas; their only output is heated ground water. That is why there is little if any deposition of minerals on Steaming Bluff, in contrast to the heavy deposition of minerals at Sulphur Bank.

The source of the heat below Steaming Bluff and Steam Vents is unclear. It could be the same as the source of heat for Sulphur Bank, but no direct evidence exists for a common source. One or more cooling intrusions of magma below the area, isolated from Sulphur Bank, could also be a heat source.

Steaming Bluff, Steam Vents, and Sulphur Bank definitely share one characteristic. Each contains vents that are distributed along cracks and faults that are concentric to the caldera. In other words, cracks related to the caldera provide the pathways up which heat escapes to the open air. Cracks could open in all three areas unexpectedly or, more commonly, during earthquakes. The volcanic ash deposits underlying the ground surface are more altered chemically in the Sulphur Bank area, and so ground instability is somewhat less there than at Steam Vents, Steaming Bluff, or along the trail north of Crater Rim Drive.

Vegetation

There are four basic vegetation habitats within the affected environment: rain forest, grassland, steam vents, and Sulphur Bank. The rain forest with 40-50 foot tall `ohi`a trees is found along the trail leading down from the Pa hula (by the Kilauea Visitor Center) and along the Sulphur Bank Road from Crater Rim Drive. Extensive mats of uluhe fern dominate the understory. Gaps in the forest are dominated by the invasive alien tibouchina. The rain forest bordering Sulphur Bank and the portion of the Sulphur Bank trail paralleling the Crater Rim Drive is shorter statured, 20-30 feet tall. Uluhe fern also dominate the understory.

The open area west of Sulphur Bank to Steam Vents is grassland dominated by alien broomsedge grass. Sedges and alien sword fern are also present, along with uluhe and several scattered clumps of short `ohi`a and wawae`iole or club moss. Subsurface temperatures are probably too great to permit forest growth in the grassland habitat.

Two microhabitats are present. Steam vent openings are present in the rainforest, the grassland, the Sulphur Bank area, and, of course, at Steam Vents. These may be partially vegetated with mosses, wawae`iole, sword fern, or other ferns. The solfatara field (Sulphur Bank) is another extreme environment. It is almost completely barren of vegetation, although young `ohi`a occur in a few sheltered sites.

The upper part of the affected environment between the Pa hula and the trail leading down to Sulphur Bank is a managed landscape. It consists of mowed grass with scattered native `ohi`a and koa trees.

Currently, vegetation is affected by foot trampling and vehicles around the Sulphur Bank road.

Geothermal microorganisms

Sulphur Bank and Steam Vents may support unusual communities of heat or sulfur tolerant bacteria, fungi, and other microorganisms. These kinds of organisms are often called extremophiles. Several research permits have been granted recently for biologists to investigate steam and lava flow environments in the park to search for extremophiles including novel species. Research is just beginning on geothermal microorganisms in the park.

Wildlife

Native birds including `apapane, `oma`o, and `amakihi utilize `ohi`a forest around Sulphur Bank, Steam Vents, and elsewhere in the Kilauea summit area. The patchy nature of the forest means that native bird densities are lower than other places on Kilauea summit such as near the Thurston Lava Tube.

Threatened and Endangered Wildlife - Nene

Nene, an endangered Hawaiian goose, have periodically been reported in the Steam Vents area; their use of the area appears to be occasional. They have not been reported at Sulphur Bank. There are no other threatened or endangered wildlife reported for the area encompassed by the proposed action.

Visitor Use

Congress established the park in 1916 primarily to protect active volcanic processes and landscapes, and to make them available to the public. Questions and interest regarding volcanic processes are the most common visitor inquiries received by the park staff. Hawai`i Volcanoes National Park is a major tourist destination for the State of Hawai'i. Based on four samples during May and July 2002, it is estimated that about 1,100 visitors per day use the Sulphur Bank area. This amounts to approximately 400,000 visitors per year. Park visitation is constant throughout the year and there are no significant weekly peaks in use.

Traffic congestion frequently occurs at Sulphur Bank as cars and busses attempt to circulate through on the narrow road and short diameter turnaround. There is no designated parking; vehicles are parked along the road, frequently off pavement on fragile ground. Owing to ongoing natural chemical alteration of the substrate, cracks and holes can open unexpectedly, allowing hot sulfurous steam to escape. Care needs to be taken when walking in the area. Visitors may be exposed to unsafe conditions at Sulphur Bank including the potential to break through the thin crust and fall into cracks and geothermal features. The trail into Sulphur Bank is not accessible to persons with mobility disabilities. There is no designated handicapped accessible parking at the Steam Vents parking area, one of the Sulphur Bank trailheads. There is handicapped accessible parking at the Kilauea Visitor Center, the other Sulphur Bank trailhead; however, the trail leading to Sulphur Bank from this area is frequently greater than a 5% grade.

Interpretation

Sulphur Bank is one of the primary places for meeting an important interpretive objective - increasing visitor understanding of active volcanic processes at Hawai`i Volcanoes National Park. The active volcanic processes that created the islands of Hawai`i are apparent in the

sulfurous steam escaping from the vents and cracks in this area. However, due to the lack of interpretation at the site, there is a lack of awareness about the Sulphur Bank resources, the relationship to volcanic processes, and the relationship to Native Hawaiians.

Environmental and cultural education for school groups is conducted at Sulphur Bank. Students engage in activities such as measuring the temperature of the steam at various depths in the Sulphur Bank vents, and observing the structure of the sulfur crystals in the area.

Visual Quality

The Sulphur Bank area is positioned in the landscape at the base of a wooded hillside. Its yellow color contrasts with the green hues of the surrounding vegetation. Sulphur Bank is adjacent to a grassland that contains numerous steam vents, which create an ever changing, foggy/misty effect in the entire area. Primary distant views of Sulphur Bank are from the trail as it enters the area both from the Pa hula side and the Steam Vents side. The primary close-up views are of the steaming vents, sulfur crystals, ash deposits, and native vegetation. Vegetation provides a visual buffer for much of Sulphur Bank and the Sulphur Bank Trail from vehicles traveling on the Crater Rim Drive. The Sulphur Bank Road, which leads from the Crater Rim Drive to Sulphur Bank, has no visual screening. The road and vehicles are intrusions on the visual quality of the Sulphur Bank area.

Soundscape

Preservation of natural soundscapes is an important mission of the NPS. Natural soundscapes are defined in NPS Management Policies 2001 as a combination of all the natural sounds that occur in a park together with the physical capacity for transmitting natural sounds. Natural sounds occur within and beyond the range of sounds that humans can perceive, and can be transmitted through air, water, or solid materials. The proposed project area is bordered by the Crater Rim Drive; a portion of the Sulphur Bank Trail crosses this road. The Sulphur Bank trailheads are adjacent to parking lots at the Kilauea Visitor Center and Steam Vents, both off Crater Rim Drive a primary park road. The Sulphur Bank Road leads from Crater Rim Drive to Sulphur Bank. Passenger vehicles and small busses travel frequently on the Sulphur Bank Road. While State Highway 11 is not visible from Sulphur Bank, vehicles on this highly traveled road are often heard.

Cultural Resources

Kilauea, one of the world's most active volcanoes, is listed on the National Register of Historic Places (National Register) for its association with Native Hawaiians and its association with science. Culturally important to Native Hawaiians, Kilauea is considered the home of Pele, a central deity of great importance in the past as well as in the present. Kilauea has drawn explorers and scientists, since the early 1800s, to observe and research active volcanism. The U.S.G.S. Hawaiian Volcano Observatory, located along the rim of the caldera, was founded in 1912 by Thomas A. Jaggar. It continues to be a center for researching active volcanism and volcanic processes.

Sulphur Bank is located on the northeastern boundary of the greater Kilauea Caldera. The rather flat area is interspersed with faults and cracks that allow steam and volcanic gases to reach the surface. The area is significant to Native Hawaiians. The steam and sulfur represent natural features of Pele and are considered to aid in ritual cleansing. For westerners, the steam

was considered therapeutic for healing a number of different ailments. The Sulphur Bank area was identified as a point of interest as early as 1846 on a map of the Kilauea area. Early photographs taken of the area (ca. 1880) show the location of a large steam house that once stood near Sulphur Bank. The 1889–1940 Volcano House was situated to the southeast of Sulphur Bank. In 1925 several boreholes were sited near Sulphur Bank and used for steam experiments by Thomas A. Jaggar. One of the boreholes was covered by rock once the metal structure was removed; this site is next to the Sulphur Bank Road. The National Park Service first developed the area for visitor use and constructed the road in 1927 (Superintendent's Report, March 1927). The single lane, loop road into the site allowed visitors to view the sulfur-encrusted bank from their vehicles. The construction pre-dated the original master plan for the park development.

Archeology

There are no known archeological sites identified within the proposed action's area of potential effect.

Historic Structures

Historic structures eligible for inclusion in the National Register in the proposed action's area of potential effect include roads, trails, and a borehole. The roads and trails are discussed under Cultural Landscapes.

The 1925 borehole was used for steam experiments by Thomas A. Jaggar, renowned volcanologist, and is associated with the Kilauea Crater (sic) National Register site. While not mentioned in the National Register nomination, the 1925 borehole should be considered eligible for listing in the National Register under National Register Criterion A, association with events that have made a significant contribution to the broad patterns of our history (volcanology research), and Criterion B, association with the lives of persons significant in our past (Thomas A. Jaggar). Although the above ground structure was removed, the borehole retains integrity of location, setting, feeling, and association.

Cultural Landscapes

A cultural landscape is "a reflection of human adaptation and use of natural resources and is often expressed in the way land is organized and divided, patterns of settlement, land use, systems of circulation, and the types of structures that are built. The character of a cultural landscape is defined both by physical materials, such as roads, buildings, walls, and vegetation, and by use reflecting cultural values and traditions" (DO-28). Ethnographic landscapes are discussed under ethnographic resources.

Cultural landscape associated resources within the potential area of impact include the Headquarters and Maintenance Areas Historic District; two roads, the Crater Rim Drive and Sulphur Bank Road; and two trails, the Sulphur Bank Trail and the KMC footpath/Old Volcano House Trail.

The Headquarters and Maintenance Areas Historic District was determined eligible for National Register listing under the context Historic Park Landscapes in National and State Parks (1916-1942). "The context examines the roots, policies, and principles of the style of naturalistic design practiced by the National Park Service (1916-1942), and traces the evolution of several

broad themes in American History, including conservation, public recreation, government, and landscape architecture" (1996 NPS letter to Hawai`i State Historic Preservation Officer). The historic district is comprised of NPS administrative and concessioner structures, buildings, and landscape features.

Under National Register Criterion C, properties that embody distinctive characteristics of a type, period, or method of construction, the roads, trails, and associated features should be considered eligible for National Register listing under the context "Historic Park Landscapes in National and State Parks (1916-1942)." The roads and trails are part of the park's transportation systems and were created to facilitate access to park resources. The roads and trails exist in a landscape where natural resources and features predominate.

A portion of the Crater Rim Drive was in existence even before the park was established in 1916. Maintaining and developing the Crater Road, or Crater Rim Drive as it is known today, to provide access to Kilauea Caldera and other park resources, was an early park priority. The Crater Rim Drive loop around the caldera, a park objective since 1931, was completed in 1934. Over the years, portions of the Crater Rim Drive were relocated due to volcanic activity, but it still retains its relationship to the landscape and provides access to the Kilauea Caldera and other park resources. Numerous historic road features remain, such as masonry retaining walls, culverts, and curbstone that contribute to the character of the road. The proposed action's potential area of effect includes a small portion of the Crater Rim Drive at the Sulphur Bank Road intersection. There are no other Crater Rim Drive features, such as culverts or retaining walls, within the potential area of effect.

The single lane Sulphur Bank Road, a secondary road off Crater Rim Drive, was constructed in 1927 to provide access to Sulphur Bank (Hawai`i Volcanoes National Park Roads HAER No. HI-47:41). Before this time, a circa 1900 photograph shows a narrow path, in about the same location as the Sulphur Bank Road. A 1952 park programs review stated that no further development should take place at the site, as it is easily accessible by trail and automobile (Master Plan Development Outline, 1952:5). The road is a simple, one-lane loop road. No associated road features are apparent, but features such as curbstone may be present below the present grade at the road edge.

The Sulphur Bank Trail provides access to Sulphur Bank from the Pa hula and Kilauea Visitor Center area and from Steam Vents. The portion of the trail from the Pa hula, and perhaps all of the trail, appears to follow the route of a bridle path around the caldera that was noted on a 1939 park map (1939, Headquarters and Vicinity Map, Part of the Master Plan for Hawaii National Park). The bridle path may be associated with the Old Volcano House period (1889-1940).

The KMC Footpath/Old Volcano House Trail parallels the Crater Rim Drive. Starting at park Headquarters, it proceeds past the location of the Old Volcano House, to the Sulphur Bank Road and Crater Rim Drive intersection, and then on to Kilauea Military Camp. While this is now one trail, the two trail segments appear to have had different origins. The trail segment from the Old Volcano House location to what is now the Crater Rim Drive/Sulphur Bank Road intersection appears to be on the footprint of a circular drive that allowed vehicles to travel from Crater Rim Drive to the Old Volcano House and then back to Crater Rim Drive. The drive appears in photographs as early as circa 1900, but most likely was in existence before this time. However, the drive doesn't appear on a 1939 Master Plan map and neither does the trail. The history of the KMC footpath to the Sulphur Bank Road/Crater Rim Drive intersection doesn't

appear in the circa 1900 photographs, which isn't surprising considering that KMC didn't exist at that time and there was another path travelers could take that followed a similar route, the bridle path. It also doesn't appear on the 1939 master plan map, but is on a 1961 master plan map, labeled as KMC to Headquarters. While specific dates and history for the KMC Footpath/Old Volcano House Trail are uncertain, it is recommended that the footpath/trail should be treated as eligible for National Register listing.

Ethnographic Resources

Ethnographic resources are cultural and natural features of traditional importance to contemporary peoples and communities. The proposed project is within the Sulphur Bank and Steam Vents areas; these areas are traditionally important to Native Hawaiians and should be considered eligible for National Register listing. Kilauea Crater (sic) is listed on the National Register, in part, for its importance to Native Hawaiians. Sulphur Bank and Steam Vents are associated with Kilauea Caldera, although they are not mentioned in the National Register nomination. The Sulphur Bank area is considered fragile and critical and the park was asked to "get the traffic out" (March 14, 2002, Kupuna Community Group meeting).

Table 3: Site and Feature Summary of Cultural Resources within Potential Area of Impact

List of Classified Structures Number (LCS#)	National Register Status	Description
No number	Eligible under Historic Park Landscapes	Headquarters and Maintenance Areas Historic District
No number	Eligible under Historic Park Landscapes	Crater Rim Drive
No number	Eligible under National Register listed Kilauea Crater (sic)	Sulphur Bank – ethnographic resource
No number	Eligible under Historic Park Landscapes	Sulphur Bank Road
No number	Eligible under Historic Park Landscapes	Sulphur Bank Trail
No number	Eligible under Historic Park Landscapes	KMC Footpath/Old Volcano House Trail
No number	Eligible under National Register listed Kilauea Crater (sic)	1925 borehole for steam experiments
No number	Eligible under National Register listed Kilauea Crater (sic)	Steam Vents – ethnographic resource

ENVIRONMENTAL CONSEQUENCES OF THE PREFERRED AND OTHER ALTERNATIVES

Overview

This section of the EA discusses the potential environmental consequences of Alternatives A, B, and C.

Methodology

For the purposes of this EA, direct and indirect environmental impacts and cumulative effects of project alternatives are analyzed in terms of geographical context (site-specific, local, state, or national), duration (short or long term), and intensity (negligible, minor, or major). Direct impacts are caused by an action that occurs at the same time and place. Indirect impacts are caused by an action but occurs later in time or is farther removed in distance, but is still reasonably foreseeable. Short-term impacts are those lasting only for the duration of the project. Long-term impacts are those continuing in duration after project completion.

Impact Definition

In the absence of quantitative data, best professional judgment defined the change thresholds for analyzing an impact's intensity on natural resources, visitor use, interpretation, visual quality, and soundscape.

Negligible impact

No resources are present or there are resources present, but the action would have no direct and/or indirect impacts or only temporary impacts are expected.

Minor impact

The action would have permanent direct and/or indirect impacts on resources; however, the impacts are not substantial and highly noticeable or conditions can be imposed that mitigate and/or avoid the impacts being substantial and highly noticeable.

Major impact

The action would have permanent direct and/or indirect impacts on resources that are substantial and highly noticeable.

Cumulative Impacts

Cumulative impacts include impacts of past, present, and reasonably foreseeable future actions that cumulatively impact a particular environmental resource. These actions may occur on private or other agency lands outside the park as well as those actions occurring within the park.

Impairment

An impairment finding is required for each resource as part of the environmental analysis of project alternatives (Director's Order #12: Conservation Planning, Environmental Impact Analysis, and Decision-Making). The National Park Service Management Policies 2001 state

that impairment is an impact that would harm the integrity of park resources or values. Whether an impact meets this definition depends on the particular resources and values that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impacts; and the cumulative effects of the impact in question and other impacts. An impact to any park resource or value may constitute an impairment. An impact would be more likely to constitute an impairment to the extent that it affects a resource or value whose conservation is:

- Necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- Key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or
- Identified as a goal in the park's general management plan or other relevant NPS planning documents.

An impact would be less likely to constitute an impairment to the extent that it is an unavoidable result, which cannot reasonably be further mitigated, of an action necessary to preserve or restore the integrity of park resources or values. Impairment may occur from visitor activities; NPS activities in the course of managing a park; or activities undertaken by concessioners, contractors, and others operating the park.

Impacts to Natural Resources

Geology

Alternative A (Preferred Alternative)

The removal of the Sulphur Bank asphalt road, restoring natural grades, and revegetating the roadway would rehabilitate the area and promote natural conditions at Sulphur Bank. Adding 1,000 linear feet of new trail at Sulphur Bank (some of this on former roadbed) and 300 linear feet of trail at Steam Vents would help limit off-trail use and help protect geologic resources. Widening and regrading the trail and construction of raised walkways in the areas of the geothermal features would help people stay on the trail and off the features. Water runoff would not be affected. A portion of the existing Steam Vents gravel parking area would be paved with asphalt and designated as a handicapped parking space. This would not impact geologic resources. The interpretive wayside exhibits would educate the public about the resources and hazards of the area, and encourage the public to stay on the trail, which would help protect the resources.

The proposed action was developed in consultation with USGS-Hawaiian Volcano Observatory geologists. Park staff would continue to consult with geologists to determine what measures would be necessary to protect geologic resources, such as monitoring during project implementation or temporary construction fencing. If a geologic resource such as a sulfur or steam vent, lava tube, or unstable ground was discovered during project implementation, work would halt in the area of the discovery. A geologist would be contacted to evaluate the resource and recommend a course of action, taking into account resource protection and safety. Alternative A would have direct and indirect, site-specific, long-term, major, positive impacts on Sulphur Bank and Steam Vents geology.

Alternative B

The impact of the road removal and turnaround, grade restoration, trail improvement, Steam Vents handicapped accessible parking, and interpretive wayside exhibits would be similar to Alternative A. New trail would be limited to the Sulphur Bank roadbed, which would result in less direct impact to Sulphur Bank, but perhaps more indirect impact from off trail visitor use. As with Alternative A, the geological resource consultation and discovery protocol would be in effect. Alternative B would have direct and indirect, site-specific, long-term, major, positive impacts on Sulphur Bank and Steam Vents geology.

Alternative C (No Action)

The Sulphur Bank Road and vehicle traffic, unimproved trail, and lack of wayside exhibits would continue contributing to the degradation of Sulphur Bank resources. Alternative C would have direct and indirect, site-specific, long-term, minor negative impacts on Sulphur Bank.

Cumulative Impacts

Road maintenance and waterline placement occurred along Crater Rim Drive within the disturbed road prism. Crater Rim Drive is scheduled for repaving in 2006. There are no known cumulative impacts.

Conclusion

Based on the impact analysis of project alternatives, Alternative A, B, or C implementation would not constitute an impairment on the geology.

Vegetation

Alternative A (Preferred Action)

The removal of the asphalt road, grade restoration, and revegetation of part of the Sulphur Bank Road corridor with native plant species such as `ohi`a, pilo, and kukaenene would rehabilitate the area and promote natural vegetation conditions. The addition of 1,000 linear feet of new trail at Sulphur Bank (some on the old roadbed) and 300 linear feet of new trail at Steam Vents would occur in an area that is a mix of non-native grasses, non-native swordfern, and native uluhe. Widening and regrading the trail and construction of raised walkways would remove approximately 10,000 square feet of trailside vegetation. Vegetation would be salvaged when possible and used in rehabilitation and revegetation of the impact areas. The common native uluhe, found throughout much of the project area, would come back gradually on its own. All project work would avoid impacts to sulfur and steam vents. Post-project monitoring of the project area would occur to detect and control non-native species. A portion of the existing Steam Vents gravel parking area would be paved with asphalt and designated as a handicapped parking space; this would not impact vegetation. The interpretive wayside exhibits would educate the public about the resources and encourage the public to stay on the trail, which would help protect the vegetation. Alternative A would have direct and indirect, site specific, long-term, minor impacts on the vegetation.

Alternative B

The removal of the asphalt road, grade restoration, and revegetation of the Sulphur Bank Road, trail improvement, Steam Vents handicapped accessible parking, and interpretive wayside exhibits would be the same as in Alternative A. New trail would be limited to the Sulphur Bank roadbed, which would result in less impact to the grassland and Steam Vents area vegetation. All project work would avoid impacting sulfur and steam vents. Alternative B would have direct and indirect, site specific, long term, minor impacts on vegetation.

Alternative C (No Action)

The Sulphur Bank Road, vehicle traffic, and unimproved trail would remain. There would continue to be a lack of wayside exhibits. Alternative C would have direct and indirect, site specific, long-term, minor impacts on vegetation

Cumulative Impacts

Road maintenance and waterline placement occurred along Crater Rim Drive but were within the disturbed road prism. The proposed 2006 Crater Rim Drive repaving would be within the road prism. There are no known cumulative impacts.

Conclusion

Based on the impact analysis of project alternatives, Alternative A, B, or C implementation would not constitute an impairment on the vegetation.

<u>Geothermal microorganisms</u>

Alternative A (Preferred Action)

Little is known about geothermal microorganisms that may be found in the park; research is just beginning. The project would avoid impacting sulfur and steam vents; this would protect geothermal microorganisms that may be found in these environments. The removal of the asphalt road, grade restoration, and revegetation of a portion of the Sulphur Bank Road corridor with native plant species would rehabilitate the area and promote natural conditions. Adding 1,000 linear feet of trail at Sulphur Bank and 300 linear feet of trail at Steam Vents, widening and regrading the trail, and construction of raised walkways in the areas of the geothermal features would have no impact on geothermal microorganisms as sulfur and steam vents would be avoided. There would be no increased erosion or runoff. A portion of the existing Steam Vents gravel parking area would be paved with asphalt and designated as a handicapped parking space; this would not impact geothermal microorganisms. The interpretive wayside exhibits would educate the public about the resources and hazards of the area, and encourage the public to stay on the trail, which may benefit geothermal microorganisms.

The proposed action was developed in consultation with USGS-Hawaiian Volcano Observatory geologists. Park staff would continue to consult with geologists to determine what measures would be necessary, such as monitoring during project implementation or temporary construction fencing, to protect geologic resources and geothermal microorganisms that may be present. If a geologic resource such as a sulfur or steam vent, lava tube, or unstable ground was discovered during project implementation, work would halt in the area of the discovery. A

geologist would be contacted to evaluate the resource and recommend a course of action, taking into account resource protection and safety. Alternative A would have direct, site specific, short term and temporary, negligible impacts on geothermal microorganisms.

Alternative B

The new trail would be limited to the Sulphur Bank roadbed. The impact of the road removal, grade restoration, Sulphur Bank roadbed trail, trail improvement, handicapped accessible parking designation, and interpretive wayside exhibits would be similar to Alternative A.

Alternative C (No Action)

The Sulphur Bank Road and vehicle traffic, unimproved trail, and lack of wayside exhibits impacts on geothermal microorganisms are unknown.

Cumulative Impacts

There are no known cumulative effects.

Conclusion

Based on the impact analysis of project alternatives, Alternative A or B implementation would not constitute an impairment on geothermal microorganisms. It is unknown if Alternative C would constitute an impairment.

Wildlife

Alternative A (Preferred Action)

The removal of the asphalt road, grade restoration, and revegetation of part of the Sulphur Bank Road corridor with native plant species would rehabilitate the area and promote natural vegetation conditions, which may be beneficial to wildlife. Adding 1,000 linear feet of trail at Sulphur Bank and 300 linear feet of trail at Steam Vents, widening and regrading the trail, and construction of raised walkways in the areas of the Sulphur Bank resources would remove approximately 10,000 square feet of trailside vegetation, but there should be little impact to wildlife. A portion of the existing Steam Vents gravel parking area would be paved with asphalt and designated as a handicapped parking space; this would not impact wildlife. The interpretive wayside exhibits would educate the public about the resources and hazards of the area, and encourage the public to stay on the trail, which would help protect the resources. Alternative A would have direct and indirect, site specific, short term, temporary, negligible impacts on wildlife.

Alternative B

The impacts would be the same as for Alternative A.

Alternative C (No Action)

The Sulphur Bank Road, vehicle use, and trail would have no impacts on wildlife.

Cumulative Impacts

Road maintenance and waterline placement occurred in the area but were within the disturbed prism of the Crater Rim Drive. There are no known cumulative effects.

Conclusion
Based on the impact analysis of project alternatives, Alternative A, B, or C implementation would not constitute an impairment on the wildlife.

Threatened and Endangered Wildlife - Nene

Alternative A (Preferred Action)

Nene have not been reported in the Sulphur Bank area; they have been infrequently reported at Steam Vents. There are two primary impact concerns, one associated with construction and one with the construction aftermath, both can be mitigated. If nene show up during the construction phase, work would halt and the Hawai`i Volcanoes National Park nene management staff contacted. Work would not resume until nene management staff give approval. Only nene management staff would attempt to flush the birds from the construction area. Wind direction and traffic would be taken into account before the birds were flushed.

The other potential impact on nene comes from the growth of roadside grasses after construction and rehabilitation is complete. Roadside grass can attract nene into the Crater Rim Drive shoulder and road, and Steam Vents parking area. Roadside grass growth would be controlled. If feasible, clean gravel would be used for trail work to limit exotic seed introduction. When trail construction and rehabilitation were completed, all trail sections close to the Crater Rim Drive and Steam Vent parking area would be monitored for grass growth. Monitoring would occur over a long enough period to outlast the seed source. If herbicides were proposed for use at any time during or after the project, nene management staff would be consulted so they could determine if there would be a potential impact on nene.

The removal of the Sulphur Bank Road, grade restoration, and road corridor revegetation with native plants would have a negligible impact on nene. Adding 1,000 linear feet of trail at Sulphur Bank and 300 linear feet of trail at Steam Vents would have negligible impacts on nene as long as the mitigation measures were followed. The trail rehabilitation, which includes widening and regrading the trail and construction of raised walkways, would remove approximately 10,000 square feet of trailside vegetation. This would have a negligible impact on nene as long as the mitigation measures were followed. A portion of the existing Steam Vents gravel parking area would be paved with asphalt and designated as a handicapped parking space; this would have a negligible impact on nene. Alternative A would have indirect, site specific, short term, temporary, negligible impacts on threatened and endangered species if the mitigation measures were followed.

Alternative B

The impacts would be the same as for Alternative A.

Alternative C

Alternative C would have no impacts on nene.

Cumulative Impacts

Road maintenance and waterline placement occurred in the area within the disturbed prism of the Crater Rim Drive. Roadside grass growth is being monitored and controlled. The proposed 2006 Crater Rim Drive would be within the road prism; roadside grass growth would be monitored and controlled. There are no known cumulative effects.

Conclusion
Based on the impact analysis of project alternatives, Alternative A, B, or C implementation would not constitute an impairment on the threatened and endangered species.

Impacts to Visitor Use

Alternative A (Preferred Action)

Implementation of the Preferred Alternative would change Sulphur Bank access from predominately vehicular to pedestrian. This change would not allow visitors to view Sulphur Bank from vehicles and may deter some visitors from visiting Sulphur Bank. However, there would be more handicapped accessible trail than currently exists. This, along with the new trail, would allow all visitors greater access to the Sulphur Bank resource. The experience for pedestrians including accessibility, safety, and resource access would be improved. Park staff do not expect an increase in visitor use at Sulphur Bank or Steam Vents. However, it is anticipated that trail use would increase from the Kilauea Visitor Center and Steam Vents Sulphur Bank trailheads because people would no longer be able to drive to Sulphur Bank.

The 1,000 linear feet of new trail at Sulphur Bank would allow visitors closer access to Sulphur Bank and the trail would be accessible. The NPS anticipates a reduction in off trail use by visitors that currently go off trail to see more of Sulphur Bank. This would help protect the fragile landscape and provide a safer visitor experience. The 300 linear feet of new trail at Steam Vent would provide an accessible trail connection between the Steam Vent handicapped accessible parking space and the Sulphur Bank Trail.

Widening and regrading the trail and constructing raised walkways in the areas of the Sulphur Bank resources would increase pedestrian accessibility and safety. The new and rehabilitated trail sections would provide an improved trail surface and some grades equal to or less than 5%. This would allow for greater use by persons with mobility disabilities and would be safer for all visitors. Trail sections with grades greater than 5% would be posted as such.

Visitors would park at the Kilauea Visitor Center or Steam Vents parking area to access the Sulphur Bank Trail. The Kilauea Visitor Center has handicapped accessible parking; however, the trail leading to Sulphur Bank from this area would still have grades greater than 5% even after trail rehabilitation (due to topography). The trail into Sulphur Bank from Steam Vents would be accessible and no greater than a 5% grade. A portion of the existing Steam Vents gravel parking area would be paved with asphalt and designated as a handicapped parking space; there currently is no designated handicapped accessible parking there. No new parking would be added at the Kilauea Visitor Center or Steam Vents. It is anticipated that both parking areas would have an increase in time that vehicles are parked. Due to parking lot size, the Kilauea Visitor Center would more easily absorb this increase than Steam Vents. At times, visitors may want to park in the Steam Vents parking area and space would not be available.

The proposed interpretive wayside exhibits would provide for a more informed visitor experience at Sulphur Bank; they would also enhance the visitor experience in other areas of the park. The interpretive messages would educate the public about the natural and cultural resources and hazards of the area, and encourage the public to stay on the trail. Alternative A would have direct and indirect, site specific and local, long term, major, positive impacts on visitor use.

Alternative B

The Sulphur Bank Road removal, grade restoration, and revegetation of part of the road corridor; trail rehabilitation; and Steam Vents handicapped accessible parking would be similar to Alternative A. The Alternative B new trail would be limited to the Sulphur Bank roadbed. This would reduce visitor access to the Sulphur Bank resource, which would reduce the visitor experience. There would be no Steam Vents handicapped accessible trail from the parking area to the Sulphur Bank Trail. This alternative would not take advantage of the site's potential as an interpretive resource, which would affect the visitor experience. Visitors would not gain as much appreciation for the Sulphur Bank resource as they would in Alternative A. The trail configuration would be more confusing to visitors than the Alternative A configuration. It would be less clear to visitors which way they should travel on the trail to best experience the resource and the interpretive wayside exhibits. As a result, visitors may have less understanding of the need to stay on the trail for resource protection and for their safety. Alternative B would have direct and indirect, site specific and local, long term, minor impacts on visitor use.

Alternative C (No Action)

Visitors would be able to drive to Sulphur Bank and view the resource from vehicles. Pedestrian access and accessibility would not be improved; visitor safety would not be improved. There would be no designated, handicapped accessible Steam Vents parking. The lack of interpretive waysides would hinder visitor understanding and safety. Alternative C would have direct and indirect, site specific, long term, minor impacts on visitor use.

Cumulative Impacts

There are no known cumulative impacts.

Conclusion

Based on the impact analysis of project alternatives, Alternative A, B, or C implementation would not constitute an impairment on visitor use.

Impacts to Interpretation

Alternative A (Preferred Action)

Alternative A would facilitate meeting an important interpretive objective, that of increasing visitor understanding of active volcanic processes in the park. The removal of the asphalt road, grade restoration, and revegetation of part of the Sulphur Bank Road corridor with native plant species would rehabilitate the area and promote natural conditions. The 1,000 linear feet of new trail at Sulphur Bank, 300 linear feet of new Steam Vents Trail, rehabilitated trail, and constructing one handicapped accessible Steam Vents parking space would facilitate visitor access to Sulphur Bank and provide for increased interpretive opportunities. The interpretive

wayside exhibits would educate the public about the natural and cultural resources and hazards of the area, and encourage the public to stay on the trail. The interpretive wayside exhibits would be designed and placed to provide a sequential message and experience. The Alternative A trail would facilitate visitor travel along the trail in the appropriate wayside exhibit sequence. The interpretive messages would be applicable to other areas of the park as well. Alternative A would have direct and indirect, site specific and local, long term, major, positive impacts on interpretation.

Alternative B

Alternative B would only partially meet the interpretive objective of increasing visitor understanding of active volcanic processes in the park. The Sulphur Bank Road removal, grade restoration, and revegetation of part of the road corridor; trail rehabilitation; and Steam Vents designated handicapped accessible parking would be similar to Alternative A. The Alternative B new trail would be limited to the Sulphur Bank roadbed. This alternative would not take advantage of the site's potential as an interpretive resource. The trail configuration would be more confusing to visitors than the Alternative A configuration. It would be less clear as to which way to travel on the trail to best experience the resource and the interpretive waysides. The interpretive wayside exhibits would be designed and placed to provide a sequential message and experience. With a more confusing trail configuration, visitors have a potential to be out of sequence with the interpretive waysides. The interpretive message would be less clear for visitors. Resource understanding would be reduced and visitors may have less understanding of the need to stay on the trail for resource protection and for their safety. Alternative B would have direct and indirect, site specific and local, long term, minor positive impacts on interpretation.

Alternative C (No Action)

The retention of the Sulphur Bank Road, and no new trail, trail improvement, Steam Vents handicapped accessible parking, and interpretive wayside exhibits would continue to limit the interpretation opportunities at Sulphur Bank. Alternative C would have direct and indirect, site-specific and local, long-term, minor impacts on interpretation.

Cumulative Impacts

There are no known cumulative impacts.

Conclusion

Based on the impact analysis of project alternatives, Alternative A, B, or C implementation would not constitute an impairment on interpretation.

Impacts to Visual Quality

Alternative A (Preferred Action)

Visual quality at the Sulphur Bank area would be improved and the natural scene would predominate with the implementation of the Preferred Alternative. This would be primarily due to the removal of the Sulphur Bank Road and vehicles, grade restoration, and revegetation with native species. A portion of the new trail would be placed on the Sulphur Bank roadbed; some

new trail would be placed in an area where there is no existing trail or road. This would have a minor effect on the Sulphur Bank visual quality. The new trail at Steam Vents would be at the edge of the existing parking area and would have a negligible effect on Steam Vents visual quality.

Widening and regrading the trail and construction of raised walkways in the areas of the vents would remove approximately 10,000 square feet of trailside vegetation. This would result in greater visibility of the trail. A portion of the existing Steam Vents gravel parking area would be paved with asphalt and designated as a handicapped parking space. This would have a negligible impact on the visual quality. The interpretive wayside exhibits would be placed along the trail and would have a minor effect on visual quality. Alternative A would have direct, site specific, long term, major, positive impacts on visual quality.

Alternative B

The impact of the road removal, grade restoration, revegetation, trail improvement, and interpretive wayside exhibits would be the same as in Alternative A. New trail would be limited to the Sulphur Bank roadbed; this would reduce the visual impact of new trail on the Sulphur Bank landscape and may result in less impact than Alternative A. Alternative B would have direct, site specific, long term, minor, positive impacts on visual quality.

Alternative C (No Action)

The Sulphur Bank Road and vehicle use would continue to interfere with the natural scene and natural processes. There would be no new trail; this would reduce the visual impact of the trail on the Sulphur Bank landscape and result in less trail impact than Alternative A. Alternative C would have direct, site specific, long term, minor impacts on visual quality.

Cumulative Impacts
No other projects are planned that would contribute to a cumulative effect on visual quality.

Conclusion

Based on the impact analysis of project alternatives, Alternative A, B, or C implementation would not constitute an impairment on visual quality.

Impacts to Soundscape

Alternative A (Preferred Action)
Removal of the Sulphur Bank Road would eliminate vehicles from Sulphur Bank, which would significantly reduce vehicle sounds at Sulphur Bank. Vehicle sounds would not be eliminated, as sounds from vehicles traveling on Crater Rim Drive and State Highway 11 would be audible. Park staff do not expect an increase in visitor use at Sulphur Bank. However, it is anticipated that trail use would increase from both the Kilauea Visitor Center and Steam Vents Sulphur Bank trailheads. This increased use may result in an increase in human sounds along the trail. Road removal, grade restoration, trail construction, trail rehabilitation, constructing one handicapped accessible Steam Vents parking space, and interpretive wayside exhibit installation would result in temporary, construction related sounds being added to the soundscape. These sounds would end when the construction was completed. Alternative A

would have a direct, site specific, long term, major, positive impact on the Sulphur Bank soundscape.

Alternative B
The alternative B impacts would be similar to Alternative B. There would be a reduction in the temporary construction generated sounds, over those in Alternative A, because new trail would be limited to the Sulphur Bank roadbed. Alternative B would have a direct, site specific, long term, major, positive impact on the Sulphur Bank soundscape.

Alternative C (No Action)
Alternative C retains the Sulphur Bank Road. Vehicle sounds would continue to have a direct impact on the Sulphur Bank soundscape. There would be no increase of human sounds along the trail. There would be no temporary construction related noises. Alternative C would have a direct, site specific, long term, minor impact on the Sulphur Bank soundscape.

Cumulative Impacts
Sounds from vehicles traveling on Crater Rim Drive and State Highway 11 are audible from Sulphur Bank; this would continue. Projects such as road or trail maintenance would occur that may have temporary impacts on the Sulphur Bank soundscape. The cumulative impacts from vehicles traveling on Highway 11 and Crater Rim Drive and projects in the vicinity would be expected to have direct and indirect, site specific, long term, minor impacts on the Sulphur Bank soundscape.

Conclusion
Based on the impact analysis of project alternatives, Alternative A, B, or C implementation would not constitute an impairment on the Sulphur Bank soundscape.

Impacts to Cultural Resources

Impact Definition

Section 106 of the National Historic Preservation Act (NHPA) requires federal agencies to consider the effects of their actions on cultural resources listed or eligible for listing on the National Register (referred to as historic properties in NHPA). The change thresholds for analyzing impact intensity on cultural resources are defined in accordance with Section 106.

Negligible impact

No historic properties affected. There are no National Register listed or eligible cultural resources present within the area of potential effect (APE) or there are cultural resources present but located more than 30 feet away and the action would have no direct and/or indirect impacts on them.

Minor Impact

No historic properties adversely effected. There are National Register listed or eligible cultural resources located within 30 feet of the APE; however, conditions can be imposed on the action that mitigate or avoid direct and/or indirect impacts on them.

Major Impact

Historic properties would be adversely affected. The action would directly or indirectly alter characteristics of a cultural resource that qualify it for listing/eligibility in the National Register.

Archeology

Alternative A (Preferred Action)

There are no archeological sites within the project's area of impact. Alternative A would have a negligible impact on archeological resources. There would be no affect to archeological resources.

Alternative B

Same as Alternative A.

Alternative C (No Action)

Same as Alternative A.

Cumulative Impacts
Same as Alternative A.

Conclusion

Based on the impact analysis of project alternatives, Alternative A, B, or C implementation would not constitute an impairment on archeological resources.

Historic Structures

Alternative A (Preferred Action)

Alternative A would have no effect on the 1925 Borehole. The road removal would be designed to avoid affecting the 1925 Borehole. Before the road is removed, the 1925 Borehole would be photographically documented using 35-mm black and white film (which is more archivally stable than digital photographs or 35-mm color film). Alternative A would have a direct, site specific, short term, minor impact on the 1925 borehole.

Alternative B

Impacts would be the same as for Alternative A.

Alternative C (No Action)

The Sulphur Bank Road would be retained; there would no impact to the 1925 Borehole.

Cumulative Impacts
There are no actions that have occurred or are planned that would have a cumulative impact on the 1925 Borehole.

Conclusion

Based on the impact analysis of project alternatives, Alternative A, B, or C implementation would not constitute an impairment on the historic structures.

Cultural Landscapes

Alternative A (Preferred Action)

The area of potential impact includes the Headquarters and Maintenance Areas Historic District, Crater Rim Drive, Sulphur Bank Road, Sulphur Bank Trail, and KMC Footpath/Old Volcano House Trail. The impact of the road removal, grade restoration, revegetation, new trail, trail rehabilitation, handicapped accessible Steam Vents parking space, and interpretive wayside exhibits on cultural landscapes would vary depending on the specific resource.

There would be no adverse effect on the Headquarters and Maintenance Areas Historic District.

The Sulphur Bank Road removal would be an adverse effect because the action would directly alter characteristics that quality the road for National Register eligibility. The Sulphur Bank Road is affecting Sulphur Bank geologic resources. The traffic volume has exceeded the designed carrying capacity of the road and there are no geologically acceptable options for road widening or relocation. Removing the road and having access by trail would continue to provide for public access, while allowing a more natural setting in which to view Sulphur Bank. Natural processes of thermal activity would dominate the scene. A portion of the new trail would be on the former Sulphur Bank roadbed. Before the road is removed, it would be photographically documented using 35-mm black and white film (which is more archivally stable than digital photographs or color film). There are no apparent road features other than the single lane loop road. If road features such as curbstones were discovered during road removal, they would be photographically documented and salvaged for use in other park projects. Park staff consulted with the Hawai`i State Historic Preservation Officer's (SHPO) Historic Preservation Division (SHPO HPD) staff on the proposed action, effect on Sulphur Bank Road, and mitigation measures. The Advisory Council on Historic Preservation (Advisory Council) would be notified of the adverse effect finding. Consultation with SHPO, and the Advisory Council if they decide to participate, would conclude with the preparation of a Memorandum of Agreement documenting the mitigation measures that were agreed to by the park superintendent and the SHPO, as well as the Advisory Council if they choose to be involved.

At the Crater Rim Drive and Sulphur Bank intersection, the natural grade would be restored on the former Sulphur Bank roadbed and the area revegetated. This would have no adverse effect on Crater Rim Drive.

The addition of new trail would have no adverse effect on the Sulphur Bank Trail or the KMC Footpath/Old Volcano House Trail. The new trail is an addition to these existing trails, not a replacement. Portions of the new trail would follow the alignment of the Sulphur Bank Road turnaround in the loop or cul-de-sac pattern. Trail rehabilitation would help to protect the natural landscape features. Existing trail would be rehabilitated to a consistent 4-foot width with 5-foot wide trail segments to permit passing of wheelchairs. Sections of the Sulphur Bank Trail would be regraded to 5% or less for handicapped accessibility. Raised walkways would be constructed where there are sulfur or steam vents. The trail alignment would remain the same, except for the possibility of minor realignments to bring portions of the Sulphur Bank Trail to a

5% or less grade. If trail features such as curbstone were discovered during the project, the features would be documented and left in place, incorporated into trail rehabilitation, or salvaged for use in other park projects. Where the KMC Footpath/Old Volcano House Trail crosses the Sulphur Bank Road at the intersection with Crater Rim Drive, the regrading and revegetation of the Sulphur Bank roadbed would allow for a continuation of the trail through this area. The new and rehabilitated trail sections would be designed to retain historic trail design features when feasible.

There would be no adverse effect on cultural landscapes from constructing a Steam Vents handicapped accessible parking space within the graveled portion of the parking area. The interpretive wayside exhibits would educate the public about the area resources and encourage the public to stay on the trail. This would help protect the natural features that contribute to the landscape setting of the trails. The interpretive wayside exhibits would have no adverse effect on the trails.

Alternative A would have direct and indirect, site specific, long term, major impacts on cultural landscapes. There would be an adverse effect on cultural landscapes because of the Sulphur Bank Road removal, but the adverse effect would be mitigated through execution and implementation of a memorandum of agreement.

Alternative B

The impact of the road removal, grade restoration, revegetation, trail improvement, handicapped accessible Steam Vents parking space, and interpretive wayside exhibits would be similar to Alternative A, but new trail would be limited to the Sulphur Bank roadbed. Because trail placement would be on the roadbed, a semblance of the Sulphur Bank Road would remain. There would be no adverse effect to the road. Alternative B would have direct and indirect, site specific, long term, minor impacts on the cultural landscapes. There would be no adverse effect on cultural landscapes.

Alternative C (No Action)

The constructed features of the historic era cultural landscape would remain (road and trail). However, the designed carrying capacity of the Sulphur Bank Road has been exceeded by the quantity of automobiles and busses that frequent the area. The road and vehicles are impacting the Sulphur Bank resources. Alternative C would have direct and indirect, site specific, long-term minor impacts on cultural landscapes. There would be no adverse effect on cultural landscapes.

Cumulative Impacts

No other projects are planned that would contribute to cumulative impacts on cultural landscapes.

Conclusion

Alternative A would result in an adverse impact but the impact would be mitigated. Therefore, Alternative A, as well as Alternative B and C, would not constitute an impairment on the cultural landscapes.

Ethnographic Resources

Alternative A (Preferred Action)

The Sulphur Bank area, which is ethnographically important to Native Hawaiians, would be affected by the project; the impact would primarily be positive. Road removal, grade restoration, and revegetation would promote natural processes. Adding 1,000 feet of new trail would allow pedestrians to experience more of Sulphur Bank, while protecting the fragile landscape. The NPS anticipates a reduction in off-trail use by visitors that currently go off-trail to see more of Sulphur Bank. Adding 300 feet of trail at Steam Vents would provide an accessible trail between the Steam Vents handicapped accessible parking space and the KMC Footpath/Old Volcano House Trail leading to Sulphur Bank Trail. Widening and regrading the trail into Sulphur Bank and construction of raised walkways in the areas of the Sulphur Bank and steam vents would help to protect the natural landscape features, which are important to Native Hawaiians. Care would be taken to avoid sulfur vents and steam vents during the project.

Native Hawaiians at the park's July 7, 2000, and March 14, 2002, Kupuna Community Group meetings were supportive of removing the Sulphur Bank Road and expressed agreement with the resources protection and accessibility aspects of the proposal. The park was asked to "get the traffic out." The need for handicapped accessible parking was mentioned as a concern. A Native Hawaiian responded to this concern by commenting that benches along the new trail would help to offset the longer walk needed to access Sulphur Bank. One handicapped accessible parking space would be constructed at Steam Vents within the gravel portion of the parking area. The parking space would be paved with asphalt. Comments from Native Hawaiians at the March 14, 2002, Kupuna Community Group meeting were more concerned with the effect of the increased volume of visitors on ethnographic resources and values at the Steam Vents and Kilauea Caldera rim than with the potential increased volume at Sulphur Bank. Alternative A would only add one parking space at Steam Vents and that space would be designated for handicapped accessible parking. The NPS does not anticipate an increase in visitor volume at Steam Vents and the Kilauea Caldera Rim, Sulphur Bank, or the Kilauea Visitor Center, because of Alternative A implementation. The duration of time some vehicles remain in the Steam Vents and Kilauea Visitor Center parking areas would increase. There may be times when the Steam Vents parking area is full and people would not be able to park; this would contribute to limiting the number of visitors at Steam Vents. At current visitation levels, this is unlikely to occur at the Kilauea Visitor Center parking area.

The interpretive wayside exhibits would educate the public about the area resources, including the interrelationship between volcanic processes and Native Hawaiians, and encourage the public to stay on the trail, which would help protect the resources.

Implementation of this alternative would help protect the geothermal landscape and processes, important components of the ethnographic landscape. Alternative A would have direct and indirect, site specific, long-term, minor impacts. There would no adverse effect to ethnographic resources.

Alternative B

The impacts to Sulphur Bank would be similar to Alternative A with the exception of new trail, which would be limited to the Sulphur Bank roadbed. This may result in less direct impact to

Sulphur Bank but perhaps more indirect impact from off trail visitor use. Alternative B would have direct and indirect, site specific, long term, minor impacts. There would be no adverse effect to ethnographic resources.

Alternative C (No Action)

The Sulphur Bank Road would continue to be congested with traffic; the road and traffic would continue to interfere with natural processes. This alternative would not respond to the request to remove vehicles from the Sulphur Bank area. The lack of an accessible trail would be partly offset by vehicle access to Sulphur Bank. The lack of interpretive wayside exhibits would continue to hinder visitor understanding of the importance of Sulphur Bank to Native Hawaiians. Alternative C would have a direct and indirect, site specific, long-term minor impact. There would be no adverse effect to ethnographic resources.

Cumulative Impacts

No other projects are planned that would have a cumulative impact on ethnographic resources.

Conclusion

Based on the impact analysis of project alternatives, Alternative A, B, or C implementation would not constitute an impairment on ethnographic resources.

REGULATORY COMPLIANCE

National Environmental Policy Act

This EA was prepared in compliance with the National Environmental Policy Act (NEPA). If the National Park Service (NPS) Pacific West Regional Director decides, based on this EA, that the project would significantly effect the human environment, a notice of intent (NOI) to prepare an environmental impact statement (EIS) would be issued. A finding of no significant impact (FONSI) would be issued if it is determined that there would be no significant impact from this project. The Regional Director would approve the FONSI.

Endangered Species Act

Section 7 of the Endangered Species Act (ESA) requires federal agencies to consult with the U.S. Fish and Wildlife Service (USFWS) on any action that may affect endangered or threatened species or candidate species, or that may result in adverse modification of critical habitat. As part of the consultation process, the NPS would seek USFWS concurrence with its determination of effect.

National Historic Preservation Act

Section 106 of the National Historic Preservation Act requires federal agencies to consider the effects of their undertakings on historic properties (resources that have been determined eligible or are listed in the National Register), and to provide State Historic Preservation Officers and as necessary, the Advisory Council on Historic Preservation a reasonable opportunity to review and comment on these actions. Section 106 also requires federal agencies to consult with Native Hawaiian organizations about the effects of their undertakings on resources of traditional

religious or cultural importance eligible for listing or listed on the National Register. The information and mitigation gathered as part of the Section 106 consultation must be included in the NEPA document.

Before preparation of this environmental assessment, the proposal was discussed with the Hawai`i Volcanoes National Park Kupuna Community Group. The kupuna expressed agreement with the resources protection and accessibility aspects of the proposal.

Park staff have consulted with the Hawai`i State Historic Preservation Officer's (SHPO) Historic Preservation Division (SHPO HPD) staff on the proposed action, effect on Sulphur Bank Road, and mitigation measures. The Advisory Council on Historic Preservation (Advisory Council) would be notified of the adverse effect finding. Consultation with SHPO, and the Advisory Council if they decide to participate, would conclude with the preparation of a Memorandum of Agreement documenting the mitigation measures that were agreed to by the park superintendent and the SHPO, as well as the Advisory Council if they choose to be involved.

Section 106 consultation with the Office of Hawaiian Affairs and Hui Malama I Na Kupuna O Hawai`i Nei would occur to identify concerns, the potential for impact that this proposal might have on cultural resources, and develop appropriate mitigation measures, as necessary.

APPENDICES

Planning Team and Consultants

Planning Team

Richard Hanson, Trails Project Manager, Hawai`i Volcanoes National Park
Steve Griswold, Landscape Architect, Olympic National Park
Lisa Duwall, Landscape Architect, Hawai`i Volcanoes National Park
Bob Dunkley, Chief of Maintenance, Hawai`i Volcanoes National Park
Tim Tunison, Chief of Resources Management, Hawai`i Volcanoes National Park
James Gale, Chief of Interpretation, Hawai`i Volcanoes National Park.
Laura Carter Schuster, Cultural Resources Manager, Hawai`i Volcanoes National Park
Catherine Lentz, Compliance Coordinator, Hawai`i Volcanoes National Park

Consultants

Darcy Hu, Ecologist, National Park Service Pacific Islands Support Office
David Foote, Chief Scientist, U. S. Geological Survey Pacific Island Ecosystems Research Center
Linda Pratt, Botanist, U. S. Geological Survey Pacific Island Ecosystems Research Center
Don Swanson, Scientist-in-Charge, U.S.G.S. Hawaiian Volcano Observatory
State Historic Preservation Officer, Historic Preservation Division
Office of Hawaiian Affairs
Hui Malama I Na Kupuna O Hawai`i Nei
Hawai`i Volcanoes National Park Kupuna Community Group
U.S. Fish and Wildlife Service

References

National Park Service. 1927. Superintendent's Annual Report. On file at Hawai`i Volcanoes National Park, Hawai`i.

National Park Service. 1939. Headquarters and Vicinity Map, Part of the Master Plan for Hawaii National Park. On file at Hawai`i Volcanoes National Park, Hawai`i.

National Park Service. 1952. Master Plan Development Outline. On file at Hawai`i Volcanoes National Park, Hawai`i.

National Park Service. 1973. Kilauea Crater National Register of Historic Places Inventory-Nomination Form. On file at Hawai`i Volcanoes National Park, Hawai`i.

National Park Service. 1975. Master Plan, Hawaii Volcanoes National Park. On file at Hawai`i Volcanoes National Park, Hawai`i.

National Park Service. 1985. Statement for Management, Hawaii Volcanoes National Park. On file at Hawai`i Volcanoes National Park, Hawai`i.

National Park Service. 1995. Historic Park Landscapes in National and State Parks National Register of Historic Places Multiple Property Documentation Form. On file at Hawai`i Volcanoes National Park, Hawai`i.

National Park Service. 1996. Letter to Hawai`i State Historic Preservation Officer. On file at Hawai`i Volcanoes National Park, Hawai`i.

National Park Service. 1997. DO-28 Cultural Resource Management Guideline. On file at Hawai`i Volcanoes National Park, Hawai`i.

National Park Service. 2000. 2001-2005 Strategic Plan for Hawai`i Volcanoes National Park. On file at Hawai'i Volcanoes National Park, Hawai`i.

National Park Service. 2000. July 7, 2000, Kupuna Community Group Meeting Minutes. On file at Hawai`i Volcanoes National Park, Hawai`i.

National Park Service. 2000. Management Policies 2001. On file at Hawai`i Volcanoes National Park, Hawai`i.

National Park Service. 2001. Director's Order -12 Conservation Planning, Environmental Impact Analysis, and Decision Making. On file at Hawai`i Volcanoes National Park, Hawai`i.

National Park Service. 2001. Historic American Engineering Record (HAER), Hawaii Volcanoes National Park. On file at Hawai`i Volcanoes National Park.

National Park Service. 2002. March 14, 2002, Kupuna Community Group Meeting Minutes, Hawai`i Volcanoes National Park. On file at Hawai`i Volcanoes National Park, Hawai`i.